Nervous Tissue

NEURONS
-Thinking cells
-possess electrical excitability some neurons propagate impulses over a short distance (less than 1 mm) within the CNS.
-the neurons that enable you to wiggle your toes (from the lumbar region of your spinal cord to the muscles in your foot).

NEUROGLIA
-Neuroglia (glial cells) play a major role in support and nutrition of the brain, but they do not manipulate information.
-they maintain the internal environment so that
neurons can do their jobs**.**

FUNCTIONS OF THE NERVOUS SYSTEM
1. Sensory-sensory receptors detectinternal stimuli,such as an increase in blood acidity, and external stimuli,such as a raindrop landing on your arm.
2.Intengrative-The nervous system integrates
(processes) sensory information by analyzing and storingsome of it and by making decisions for appropriate responses.
3.Motor- Once sensory information is integrated, the
nervous system may elicit an appropriate motor response by activating effectors(muscles and glands) through cranial and spinal nerves. Stimulation of the effectors causes muscles to contract and glands to secrete.

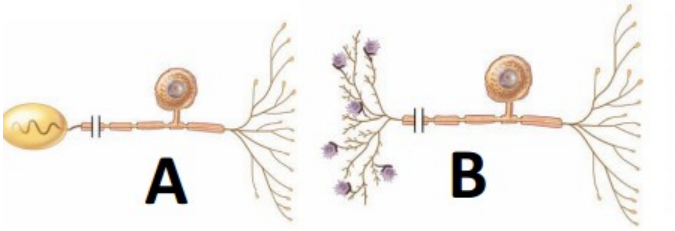
PARTS OF NEURON

1.Cell body (Perikaryon or Soma)- contains a nucleus surrounded by cytoplasm that includes typical cellular organelles such as lysosomes, mitochondria, and a Golgi complex.
NERVE FIBER- general term for any neural process that emerges from the cell body of a neuron.
(a) Multiple dendrites
(b) Single axons
2.Dendrites – (little tress) are the receiving or input portions of a neuron. They usually are short, tapering, and highlybranched.

3. Axon- single axon (axis) of a neuron propagates nerve impulses toward another neuron, a muscle fiber, or a gland cell.
axon hillock An axon is a long, thin, cylindrical projection that often joins the cell body at a cone-shaped elevation (small hill).

CLASSIFICATIONS OF NEURONS

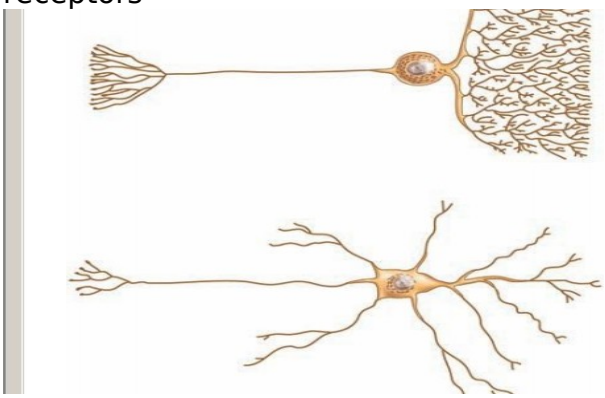
STRUCTURAL - according to the number of processes extending from thecell body.
1.Multipolar neurons - usually have several dendrites and one axon (Figure 12.3a). Most neurons in the brain and spinal cord are of this type.
2. Bipolar neurons - have one main dendrite and one axon (Figure 12.3b). They are found in the retina of the eye, in the inner ear, and in the olfactory (olfact to smell) area of the brain.
3. Unipolar neurons - have dendrites and one axon that are fused together to form a continuous process that emerges from the cell body (Figure 12.3c). These neurons are more appropriately called **pseudounipolar neuronsbecause** they begin in the embryo as bipolar neurons. During development, the dendritesand axon fuse together and become a single process.



A. MEISSNER CORPUSCLE is a touch receptor that consists of a mass of dendrites enclosed by a capsule of connective tissue.
B. MERKEL DISC is a touch receptor that consists of free nerve endings (bare dendrites) that make contact with Merkel cells of the stratum basale of the skin.

C. PACINIAN CORPUSCLE is a pressure receptor composed of a multilayered connective tissue capsule that encloses a dendrite.

D. NOCICEPTOR is a pain receptor that consists of free nerve endings (bare dendrites)
• Thermoreceptors, itch receptors, and tickle receptors



A. Purkinje cells (cerebellum)
B. Pyramidal cells (cerebral cortex)
FUNCTIONAL - according to the direction in which the nerve impulse (action potential) is conveyed with respect to the CNS.
1. Sensory of afferent neurons - either contain sensory receptors at their distal ends (dendrites) (see Figure 12.11) or are located just after sensory receptors that are separate cells.
2. Motor of efferent neurons - convey action potentials awayfrom the CNS to effectors(muscles and glands) in the periphery (PNS) through cranial or spinal nerves (see Figure 12.11). Most motor neurons are multipolar in structure.
3. Interneurons of association neurons - are mainly located within the CNS between sensory and motor neurons (see Figure 12.11). Interneurons integrate (process) incoming sensory information from sensory neurons and then elicit a motor response by activating the appropriate motor neurons. Most interneurons are multipolar in structure.

NEUROGLIA OF THE CNS

Neuroglia - glia/ glial cells
• make up about half the volume of the CNS.
• smaller than neurons, and they are 5 to 25 times more numerous.
CLASSIFICATION - classified on the basis of size, cytoplasmic processes, and intracellular organization into four types:astrocytes, oligodendrocytes, microglia, and ependymal cell.
1. Astrocytes - These starshaped cells have many processes and are the largest and most numerous of the neuroglia.

a. Protoplasmic astrocytes have many short branching processes and are found in gray matter (described shortly)
b. Fibrous astrocytes have many long unbranched processes and are located mainly in
white matter (also described shortly).

-The processes of astrocytes make contact with blood capillaries, neurons, and the pia mater (a thin membrane around the brain and spinal cord)
Functions:

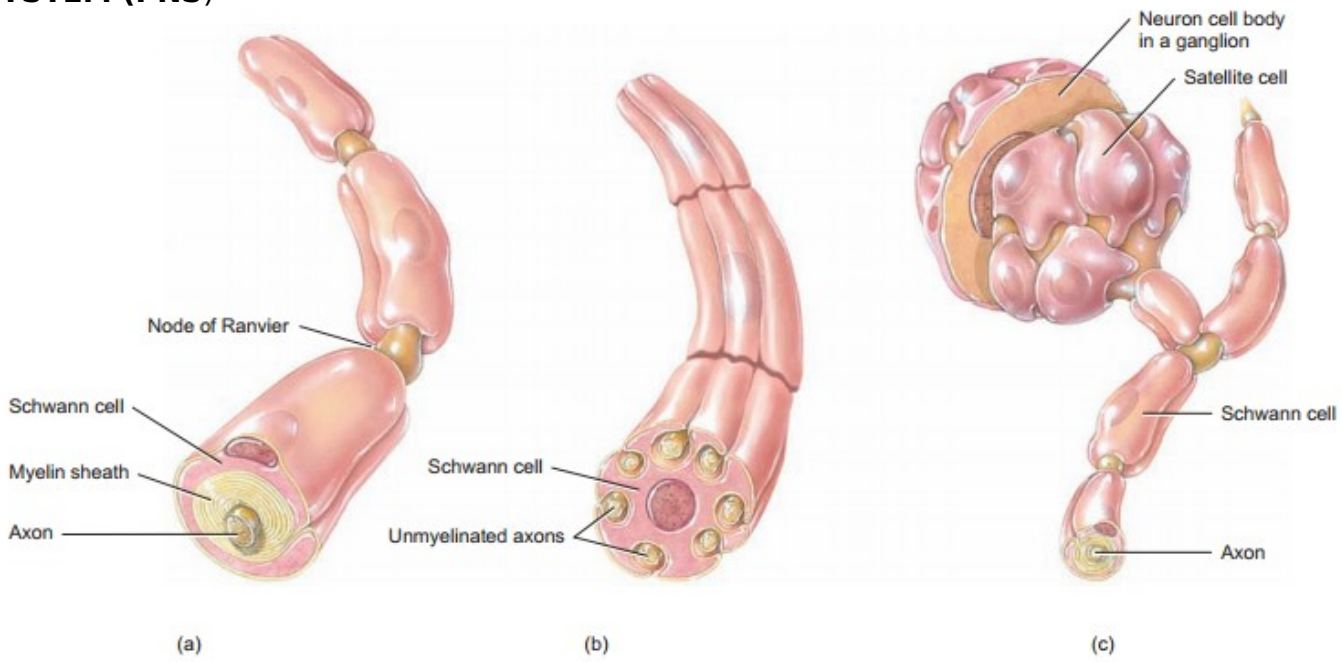
(1) Astrocytes contain microfilaments that give them considerable strength, which enables them to support neurons.
(2) Restricts the movement of substances between the blood and interstitial fluid of the CNS. (Blood-brain barrier, BBB).
(3) In the embryo, astrocytes secrete chemicals that appear to regulate the growth, migration, and interconnection among neurons in the brain.
(4) Maintain the appropriate chemical environment for the generation of nerve impulses.(e.g.K^+, take up excess neurotransmitters; and serve as a conduit for the passage of nutrients and other substances between blood capillaries and neurons.)
(5) Play a role in learning and memory by influencing the formation of neural synapse.

2. Oligodendrocytes -These resemble astrocytes, but are smaller and contain fewer processes. Oligodendrocyte processes are responsible for forming and maintaining the myelin sheath around CNS axons. As you will see shortly, the myelin sheathis a multilayered lipid and protein covering around some axons that insulates them and increases the speed of nerve impulse conduction. Such axons are said to be myelinated.
3. Microglia - These neuroglia are small cells with slender processes that give off numerous spinelike projections. Microgliafunction as phagocytes. Like tissue macrophages, they remove cellular debris formed during normal development of the nervous system and phagocytize microbes and damaged nervous tissue.

4. Ependymal cell - are cuboidal to columnar cells arranged in a single layer that possess microvilli and cilia.These cells line the ventricles of the brain and central canal of the spinal cord (spaces filled with cerebrospinal fluid, which protects and nourishes the brain and spinal cord).

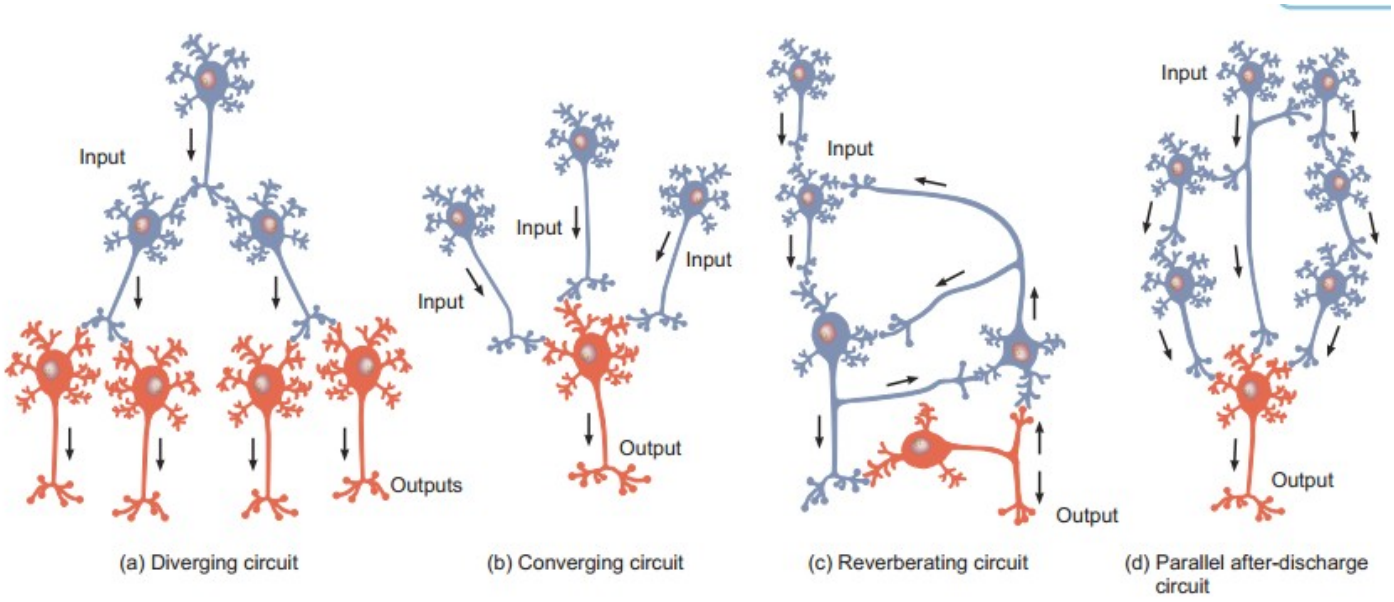
NEUROGLIA OF PHERIPHERAL NERVOUS SYSTEM (PNS)

1. Schwann cells - form the myelin sheath around a single axon. Participate in axon regeneration.
2. Satellite cells -flat cells surround the cell bodies of neurons of PNS ganglia. Regulate the exchanges of materials between neuronal cell bodies and interstitial fluid.



NEURAL CIRCUITS

1. Simple series circuit - a presynaptic neuron stimulates a single postsynaptic neuron. The second neuron then stimulates another, and so on.
2. Diverging circuit - a single presynaptic neuron may synapse with several postsynaptic Neurons.
3. Converging circuit - several presynaptic neurons synapse with a single postsynaptic neuron.
4. Reverberating circuit - the incoming impulse stimulates the first neuron, which stimulates the second, which stimulates the third, and so on.
5. Parallel after-discharge circuit - In this circuit, a single presynaptic cell stimulates a group of neurons, each of which synapses with a common postsynaptic cell. e.g. Mathematical calculations.



(a) Diverging circuit (b) Converging circuit (c) Reverberating circuit (d) Parallel after-discharge circuit

ELECTRICAL SIGNAL IN NEURONS

1. Graded potentials are used for short-distance communication only.
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REGENERATION AND REPAIR OF NERVOUS TISSUE

- nervous system exhibits **PLASTICITY**
  - the capability to change based on Experience
- level of individual neurons
  - sprouting of new dendrites
  - synthesis of new proteins
  - changes in synaptic contacts with other neurons
- **mammalian neurons have very** limited powers of REGENERATION
  - the capability to replicate or repair themselves
- PNS
  - if the cell body remains intact
  - if the Schwann cells that produce myelination remain active
- CNS
  - little or no repair of damage to neurons occur.
  - inhibitory influences from neuroglia, particularly oligodendrocytes
  - absence of growth-stimulating cues that were present during fetal development
  - after axonal damage, astrocytes form a type of scar tissue that acts as a physical barrier to regeneration